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NATIONAL AERONAUTICS
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ESDS Reuse Working Group

A Community-Developed Measurement of the Reusability of Software Through Reuse Readiness Levels

Technology standards often overlook the reuse readiness of a particular technology. Reuse readiness is the ability of a particular technology to be reused. Recognizing the need to measure the maturity of a technology for reuse, the NASA Earth Science Data System (ESDS) Software Reuse Working Group (WG) is developing the following set of Reuse Readiness Levels (RRLs) in order to facilitate the reuse of software to provide enhanced efficiency, and both cost and time savings.

The nine topic areas considered by the Working Group are:

- Documentation
- Extensibility
- Intellectual Property Issues
- Modularity
- Packaging
- Portability
- Standards Compliance
- Support
- Verification/Testing

The WG created levels for these topic areas. At least two members worked on each area's levels, with feedback from the full WG. At a WG meeting in October, the WG collaborated to create this first draft of a single, unified scale for measuring reuse maturity. This was done by cross-comparing the levels for each topic area and deciding on a description that captures the essence of all of the topic area levels combined.

For more information, please visit:
http://www.esdswg.org/softwarereuse

Draft Reuse Readiness Level Summaries

Level	Summary	Description
RRL 1	No reusability; the software is not reusable.	Little is provided beyond limited source code or pre-compiled, executable binaries. There is no support, contact information, author attribution, or rights specified, the software is not extensible, and there is inadequate or no documentation.
RRL 2	Initial reusability; software reuse is not practical.	Some source code, documentation, and contact information are provided, but these are still very limited. Initial testing has been done, but authorship and reuse rights are still unclear. Reuse would be challenging and cost-prohibitive.
RRL 3	Basic reusability; the software might be reusable by skilled users at substantial effort, cost, and risk.	Software has some modularity and standards compliance, intellectual property agreements have been proposed, some support is provided by developers, and detailed installation instructions are available, but rights are unspecified. An expert may be able to reuse the software, but general users would not.
RRL 4	Reuse is possible; the software might be reused by most users with some effort, cost, and risk.	Software and documentation are complete and understandable. Software has been demonstrated in a lab on one or more specific platforms, infrequent patches are available, and intellectual property issues have been negotiated. Reuse is possible, but may be difficult.
RRL 5	Reuse is practical; the software could be reused by most users with reasonable cost and risk.	Software is moderately portable, modular, extendable, and configurable, has low-fidelity standards compliance, a user manual, and has been tested in a lab. A user community exists, but may be a small community of experts. Authorship and rights are not specified.
RRL 6	Software is reusable; the software can be reused by most users although there may be some cost and risk.	Software has been designed for extensibility, modularity, and portability, but software and documentation may still have limited applicability. Tutorials are available, and the software has been demonstrated in a relevant environment. Intellectual property statements have been drafted, but authorship and rights have not been formalized.
RRL 7	Software is highly reusable; the software can be reused by most users with minimum cost and risk.	Software is highly portable and modular, has high-fidelity standards compliance, provides auto-build installation, and has been tested in a relevant environment. Support is developer-organized, and an interface guide is available. Software and documentation are applicable for most systems.
RRL 8	Demonstrated reusability; the software has been reused by multiple users.	Software has been shown to be extensible, and has been qualified through test and demonstration. An extension guide and organization-provided support are available. Intellectual property is reviewed in the product before release, and authorship and rights are specified.
RRL 9	Proven reusability; the software is being reused by many classes of users over a wide range of systems.	Software is fully portable and modular, with all appropriate documentation and standards compliance, encapsulated packaging, a GUI installer, and a large support community that provides patches. Software has been tested and validated through successful use of application output. Complete and clear attribution and permissions for implementation by various user levels are available.

Since this is the first draft, the WG recognizes that additional work is necessary to refine the levels to reach a more practical, usable form. Some factors already under consideration for the next revisions include:

- **Security – Could this be incorporated into verification/testing, should it be its own topic area, or is it not a factor of reusability?**
- **Use vs. reuse – When is a factor more about how good it is for your application (use) than is it ready for you to reuse (reuse)?**
- **Quantitative measures – to make the ratings easier to determine, with less ambiguity, more objective level criteria are needed.**
- **Cost – how to factor in this concern?**
- **Risk – how to factor in this concern?**
- **Topic level ratings – these are viewed as useful information for reusers, so how should the information be offered?**

Potential uses for the RRLs include:

- **Metadata for reusable software assets stored in catalogs and repositories, as a guide to reusers**
- **An indicator of areas to focus on when creating reusable assets, as a guide to providers**
- **Part of requests for proposals or contracts, asking for reuse approach or how assets are being made reusable**
- **RRL Calculator**

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